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Population study of *Allium altaicum* Pall. in Kazakhstan Altai

The purpose of this work was population studies of *Allium altaicum* Pall. on the territory of the Kazakhstan Altai in 3 territorially isolated geographical regions: Southern, South-Western Kalba Altai. As a result of the survey of the territory by the route-reconnaissance method on the ridges of Sarymsacty, Lineysky and Kalba, a study was made of populations that are characterized by different environmental conditions and altitudinal limits. Ecological and phytocenotic screening revealed that on the Sarymsacty ridge the population is located in the alpine belt in the altitudinal limit of 1870 m a.s.l., on the Lineysky ridge – in the mountain-forest, 1361 m.a.s.l. Both populations are characterized by meso-psychro-petrophytic growing conditions. On the ridge ridge Kalba, the population was examined in the mountain-steppe xero-meso-petrophytic conditions, 832 m a.s.l. Soils are mountain chernozems, slightly acidic, pH 5.6–5.9, with a high humus content from 13.5% to 14.9%, the ground cover is formed, 210–410 g/m^2. In all populations, the vegetation cover is based on herbaceous perennials; layering is not pronounced. Participation of *A. altaicum* in the formation of phytocenosis on the ridge Sarymsacty is 3.2%, Lineysky – 2.2%; Kalba – 1.8%. The florocomplex of the surveyed populations is formed from 91 species of vascular plants. The similarity of the floristic compositions of the Sarymsacty population in alpine meso-psychro-petrophytic conditions and Lineysky in mountain-forest meso-psychro-petrophytic conditions at the level of 65.0% in relation to the entire cenoflora was established, and Kalba in mountain-steppe xero-meso-petrophytic conditions this figure was 42.1%. Variability of morphometric parameters of aboveground organs of *A. altaicum* in all examined populations has an average and high level of variability from 15.0 to 26.09%, which indicates the ecological plasticity of plants. It has been established that in nature vegetative reproduction occurs only in virginal and generative plants, and nests are formed. The biomorphological parameters of the bulbs in the nest have a clearly expressed age character and vary within the same coenopopulation.

Keywords: Allium altaicum Pall., biometric parameters, Kazakhstan Altai, population, vegetation cover, floristic composition.

Introduction

Currently, the conservation of biological diversity is one of the most important problems of the modern plant world. Rare and endangered plant species have less genetic diversity than widespread ones, so they are more susceptible to extinction when environmental conditions change and the influence of the anthropogenic factor [1].

The priority task of modern botany is the development of approaches to the conservation of biodiversity, which require, first of all, a comprehensive study of the population biology of species. The most important criteria for assessing the state of populations of rare species are the morphometric characteristics of individuals and the structure of populations: abundance, age composition, spatial distribution of individuals [2].

One of the species requiring conservation in the flora of Kazakhstan is *Allium altaicum* Pall. (Altai onion, stone, wild batun) is a relic of the Ice Age, which has a mountainous Siberian-North Tien Shan area [3, 4]. In modern flora, it belongs to the family Amaryllidaceae J. St.-Hil, genus *Allium* L., names of which are adopted according to Plants of the World Online [5]. According to ecological and phytocenotic indicators, it is a cryo-xerophytized psychrophyte, which is part of scree and glacial-morainic plant groups, as well as unformed pioneer phytocenoses from the middle to upper mountain belts [6].

A. altaicum is known for many useful properties – food, medicinal, decorative and melliferous. It can be used in landscaping rocky and alpine hills, as well as to create mountain landscapes [7, 8]. It is readily used by the population for food, it is often bred in vegetable gardens called “batun”. Animals eat poorly. Honey plant. The plant produces abundant nectar [9]. At the present stage, the research is also relevant in connection with the species belonging to the wild relatives of cultivated plants [10].

Altai onion attracts the attention of scientists as a source of biologically active substances. The revealed high antioxidant activity, the ability to accumulate selenium allows us to attribute *A. altaicum* to

plants with pronounced antioxidant properties, the species is also in demand for resolving controversial issues in the field of taxonomy and phylogeny of cultivated and wild onions in Kazakhstan [11, 12].

The species needs to be protected, because due to the massive collection as a food plant, it is reducing its numbers everywhere. Currently in Russia and Mongolia it is subject to state protection with category and status 3, in Kazakhstan it is still not officially protected [13-17].

The purpose of this work was population studies of *A. altaicum* on the territory of the Kazakhstan Altai in 3 territorially isolated geographical regions: Southern, South-Western and Kalba Altai.

To achieve this goal, we solved the following tasks: the geographic distribution of the species in the region was identified; Sarymsacty, Lineysky, Kalba, the floristic composition of communities with the participation of *A. altaicum* was studied, morphometric indicators of the aboveground parts of individuals were identified, their variability was determined, some parameters of underground organs were studied depending on the location of populations and the age state of individuals.

Experimental

Population studies were carried out on the territory of the Kazakhstan Altai, the climate of which was formed under the influence of the proximity of the deserts of Mongolia and Central Asia, location in the center of the Eurasian continent, remote from the oceans, as well as under the influence of continental-oceanic air mass transfer [18]. The soils are light chestnut, which constitute the main background, against which the vertical range of soils characteristic of the region is manifested: dark chestnut, steppe chernozems and forest-steppe, gray forest soils, mountain taiga acid soils and mountain meadow soils [19]. Population studies were carried out in the Katon-Karagai, Kurchum, Glubokovsky administrative districts, as well as in the West Altai State Nature Reserve (near the town of Ridder). The route and semi-stationary studies covered the mountainous regions of the Kazakhstan Altai. Habitats of *A. altaicum* in the Southern, Southwestern and Kalba Altai were studied within the natural range.

The study of morphometric and quantitative indicators of individuals in the surveyed populations was carried out according to the methods recommended for the study of rare species [20; 21]. At the same time, micro- and macrorelief, exposure, mechanical composition of soils, total projective cover of vegetation, and floristic composition were taken into account. Due to the uneven distribution of *A. altaicum* individuals, geobotanical sites ranging in size from 10 to 15 m^2 were established. Morphometric and weight indices of aerial parts and bulbs were studied at each site according to the classification of O.V. Smirnova et al. [22], developed on the basis of the generally accepted scheme of T.A. Rabotnov [22]. In the flora and population study, the Latin names of plants are given according to the international platform POWO [5]. When analyzing quantitative indicators, statistical data processing was carried out according to the method of N.L. Udolskaya [23]. The level of variability of biometric indicators was calculated from the value of the coefficient of variation Cv: less than 12% – the level of variability is low, 13-20% – medium, 21-40% – high, more than 40% – very high [24].

Results and discussions

The field work carried out on the territory of the Kazakhstan Altai made it possible to establish specific locations of *A. altaicum*: Southern Altai – the Azutau, Sarymsacty, Narym, South Altai Tarbagatai ridges; Southwestern Altai – Lineysky, Ubinsky, Ivanovsky, Ulbinsky, Listvyaga ridges; Kalba Altai – the eastern periphery of the Kalba ridge.

In the Southern Altai, the population was examined in the Alpine belt under meso-psychro-petrophytic conditions, on the northwestern rocky slope of the ridge Sarymsacty (Fig. 1) in the area of the Burkhat pass, conditionally designated by its location as Sarymsacty. Location coordinates: N 49º 05' 35" E 86º 01' 42", 1870 m a.s.l. The analyzes showed that the soil where the population is located is slightly acidic, pH 5.7, the content of total humus is 14.9%. The ground cover is formed by litter, mainly from ground mosses and lichens, 410 g/m^2.

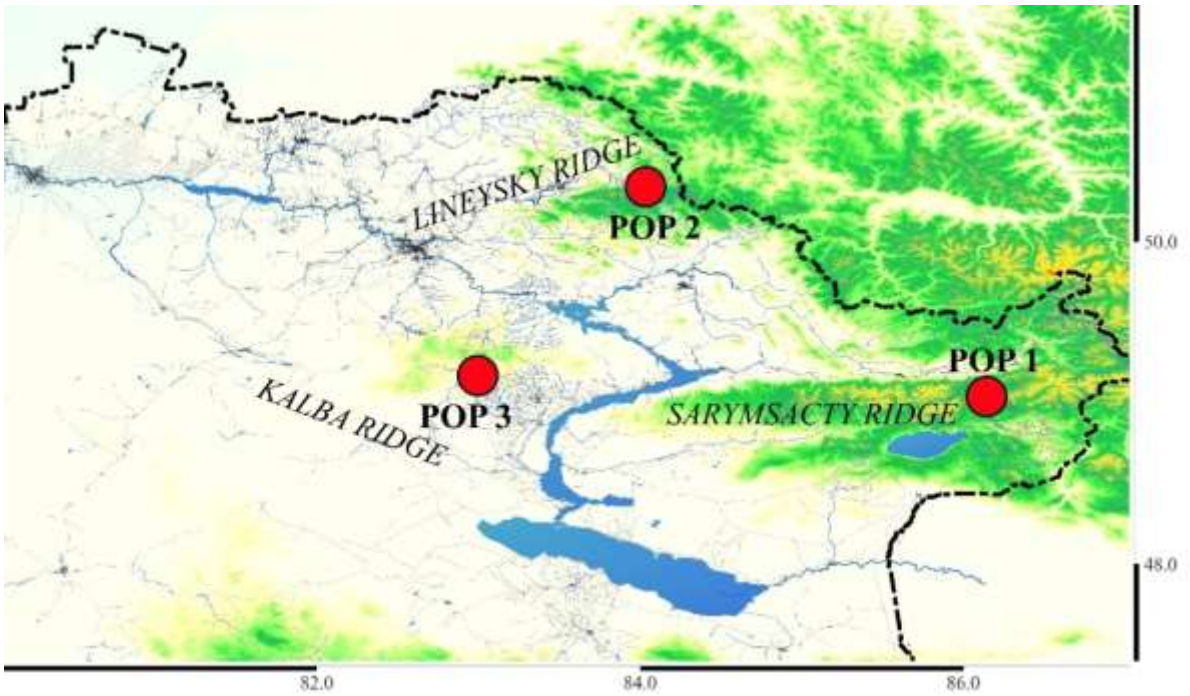

Figure 1. Location of investigated populations of *A. altaicum* in Kazakhstan Altai

The vegetation cover is formed by 66 species of vascular plants with a projective cover 55–85% (Table 1).

Table 1

Floristic composition of the surveyed populations of *Allium altaicum* in the Kazakhstan Altai

№	Species name	Population name		
		Sarymsacty	Lineysky	Kalba
1	*Abies sibirica* Ledeb.	+	+	-
2	*Adenophora lilifolia* Ledeb.	+	+	+
3	*Allium amphibolum* Ledeb.	+	+	-
4	*A. flavescens* Bess.	-	-	+
5	*A.flavidum* Ledeb.	+	+	-
6	*A. schoenoprasum* L.	+	+	+
7	*A. lineare* L.	+	+	-
8	*A. nutans* L.	+	+	+
9	*A. rubens* Schrad. ex Wild	+	+	+
10	*Aconitum altaicum* Steinb.	+	-	-
11	*A. anthoroideum* DC.	+	+	+
12	*Aquilegia glandulosa* Fisch. et Link.	+	+	-
13	*Amygdalis ledebouriana* Schlecht.	-	-	+
14	*Artemisia campestris* L.	+	-	-
15	*Aster alpines* L.	+	+	+
16	*Anemonastrum narcissiflorum* (L.) Holub	+	+	-
17	*Clematis sibirica* (L.) Mill.L.	+	+	-
18	*Bupleurum multinerve* DC.	-	+	-
19	*Betula pendula* Roth	-	-	+
20	*Berberis sibirica* Pall.	+	+	-
21	*Bergenia crassifolia* (L.) Fritsch	+	+	-
22	*Woodsia ilvensis* (L.) R. Br.	+	+	+
23	*Calamagrostis epigejos* (L.) Roth	-	+	+
24	*Campanula glomerata* L.	+	+	+

25	*Carex rupestris* All.	+	+	-
26	*C. pediformis* C. A. Mey.	+	+	+
27	*Cerastium arvense* L.	-	+	+
28	*Corydalis nobilis* (L.) Pers.	-	-	+
29	*Cotoneaster uniflorus* Bunge	+	+	-
30	*C. melanocarpus* Fisch. ex Blytt	+	+	+
31	*C. oliganthus* Pojark.	-	-	+
32	*Chamaenerion angustifolium* (L.) Scop.	+	+	-
33	*Dianthus versicolor* Fisch. ex Link	+	+	+
34	*Elymus debtatus (*Hook.f) Tzvelev subsp. *elongatiformis*	-	-	+
35	*Eremogone Formosa* (Fisch. ex Ser.) Fenzl	+	+	-
36	*Erythronium sibiricum* (Fisch. et Mey.) Kryl.	+	+	-
37	*Euphorbia macrorhiza* C. A. Mey. ex Ledeb.	-	+	+
38	*E. alpine* C. A. Mey.	+	+	-
39	*Festuca kryloviana* Reverd.	+	+	-
40	*F. borissii* Reverd.	+	+	-
41	*Fritillaria verticillata* Willd.	-	-	+
42	*Galium verum* L.	+	+	-
43	*G. boreale*L.	+	+	-
44	*Hedysarum alpinum* L.	+	+	-
45	*Hieracium umbellatum* L.	-	+	+
46	*Iris ruthenica* Ker Gawl.	+	+	+
47	*Larix sibirica* Ledeb.	+	+	-
48	*Lonicera caerulea* subsp. *altaica* (Pall.) Gladkova	+	+	-
49	*Juniperus sibirica* Burgsd.	+	+	+
50	*J. sabina* L.	+	-	+
51	*Oxytropis sulphurea* (Fisch. ex DC.) Ledeb.	+	+	-
52	*Orostachys spinosa* (L.) C. A. Mey.	+	-	-
53	*Paeonia intermedia* subsp. *intermedia* Pall.	-	-	+
54	*Pachypleurum alpinum* Ledeb.	+	+	-
55	*Patrinia intermedia (*Hornem.) Roem. et Schult.	-	-	+
56	*P. sibirica* (L.) Juss.	+	+	-
57	*Poa attenuate* Trin.	+	+	+
58	*Pedicularis elata* Willd.	+	-	-
59	*Pentaphylloides fruticosa* (L.) O.Schwarz	+	-	-
60	*Pinus sylvestris* L.	-	+	+
61	*P. Sibirica* Du Tour	+	+	-
62	*Phlomoides alpina* Pall. Adjlov. Kamelin et Makhm.	+	+	-
63	*Ph. tuberosa* (L.) Moench.	-	-	+
64	*Polemonium caeruleum* L.	+	-	-
65	*Bistorta elliptica* (Willd. ex Spreng.) Kom.	+	+	-
66	*Populus tremula*L.	-	-	+
67	*P. laurifolia* Ledeb.	+	+	+
68	*Potentilla argentea* L.	+	+	-
69	*Ranunculus polyrhizos* Steph. ex Willd.	-	-	+
70	*Rheum altaicum* Losinsk.	+	+	-
71	*Rosa spinosissima* L.	-	+	+
72	*Rhodiola rosea* L.	+	+	-
73	*R.algida* (Ledeb.) Fisch. et Mey.	+	+	-
74	*Ribes nigrum* L.	-	+	-
75	*Rubus sachalinensis* H.Lev.	+	+	-
76	*Sedum ewersii* Ledeb.	+	+	-
77	*S. hybridum* L.	-	+	+
78	*Seseli buchtormense* (Fisch.) W.D.J. Koch	+	+	+
79	*Silene graminifolia* Otth	+	+	-
80	*Spiraea chamaedryfolia* L.	-	-	+
81	*S. trilobata* L.	-	-	+

82	*S. media* Schmidt	+	+	+
83	*Solidago dahurica* (Kitag.) Kitag.exJuz.	+	+	-
84	*Sorbus aucuparia* subsp.glabrata (Wimm.et Grab.) Hedl.	+	+	-
85	*Thalictrum foetidum* L.	+	+	+
86	*Thesium repens* Ledeb.	+	-	-
87	*Thymus serpyllum* L.	-	+	+
88	*Trifolium lupinaster* L.	+	+	-
89	*Vaccinium myrtillus* L.	+	+	-
90	*Veronica spicata* L.	-	-	+
91	*Viola dissecta* Leded.	+	-	-
	Total	66	67	42

Its tiering is not expressed. Solitary specimens of *Populus laurifolia* Ledeb., *Pinus sibirica* Du Tour, *Abies sibirica* Ledeb. were noted from trees and *Sorbus aucuparia* subsp. *glabrata* (Wimm. et Grab.) Hedl. The shrub layer is dominated by *Spiraea media* Franz Schmidt – sp.; *Cotoneaster uniflorus* Bunge – sol and *Dasiphora fruticosa* (L.) Rydb – sol, *Juniperus sibirica* Burgsd. – s *Berberis sibirica* Pall. – s. Its occlusion does not exceed 01, with a coverage of no more than 1.0%. The herbaceous cover is represented by species typical of high-mountain regions: *Aquilegia glandulosa* Fisch. et Link. – sp, *Festuca borissii* Reverd. – sp, *Acontuman thoroidum* DC. – sol, *Thalictrum foetidum* L., *Galium boreale* L. – sol, *Allium altaicum* Pall. – sp., *Orostachys spinosa* (L.) C.A. May. – sol, *Campanula glomerata* L. – sol, *A. rubens* Schrad. ex Wild. – sol, *Potentilla argentea* L. – sol, *Patrinia sibirica* (L.) Juss. – sol, etc. Rare species are also found in the herbaceous cover: *Woodsia ilvensis* (L.) R.Br., *Rheum altaicum* Losinsk., *Rhodiola rosea* L., *R.algida* (Ledeb.) Fisch. et Mey., *Hedysarum alpinum* L. Individuals of the Altai onion in the area are diffusely distributed in small spots. Participation share of *A. altaicum* in the formation of phytocenosis was no more than 3.2%.

In the Southwestern Altai (southwestern periphery), the Altai onion population was surveyed in the Western Altai State Nature Reserve in the mountain forest belt under meso-psychro-petrophytic conditions on the northwestern slope of the ridge Lineysky in the area of the Chernoubinsky cordon between the mountain ranges, named by us as Lineysky. Location coordinates: N 50º 23' 08" E 84º 01' 14", 1361 m a.s.l. The total area occupied by the view is no more than 1500 m^2. Soil layer is medium thickness. The soil is rich in humus – 13.6% with a fraction of sand due to collapsing rocks, slightly acidic, pH 5.8–5.9. The litter is well expressed, 210 g/m^2. The total projective cover is heterogeneous, depending on the phytocenotic features, it ranges from 7 to 65%. In the places of growth of the Altai onion, areas with a well-developed vegetation cover were identified, in the florocomplex of which up to 67 species of vascular plants were recorded (Table 1). Layering is not expressed. The plot with the Altai onion is surrounded by shrubs *Rosa spinosissima* and *Juniperus sibirica, Spiraea media, Dasiphora fruticosa* are less common. Single bushes of *Ribes nigrum* are noted, *Abis sibirica, Laryx sibirica, Pinus sylvestris, P. sibirica, Sorbus aucuparia* subsp. *glabrata* are noted from the trees. Herbaceous plants are represented by dominants *Chamaenerion angustifolium*, *Aquillegia-glandulosa*, *A. rubens*, related species: *Carex pediformis*, *Euphorbia macrorhiza*, *Festuca borissii*, *Poa attenuata*, *Galium verum, Solidago gebleri*, *Vaccinium myrtillus*, *Silene graminifolia*. Onions occur sparsely and unevenly over the site. The share of its participation in the formation of phytocenosis was 2.2%.

On the territory of the Kalba Altai, the population of *A. altaicum* was described in mountain-steppe xero-meso-petrophytic conditions in the eastern part of the Kalba Ridge on the northeastern rocky slope. Location coordinates: N 49º 29' 37" E 82º 36' 19", 832 m a.s.l. m. The soil layer is formed only in places where plants grow up to 35 cm, refers to mountain podzolized chernozems, with a total humus content of 13.5%, slightly acidic, pH 5.6-5.8. In the mechanical composition in the horizon from 0 to 25 cm, small cartilages predominate – 34.4% and coarse sand – 35.9%. Altai onions grow locally along the cracks of granite outcrops filled with soil or among sparse thickets of shrubs – *Spirea trilobata* L., *Cotoneaster oliganthus* Pojark., forming small micropopulations. Vegetation cover is poorly developed, represented by forb groups. There are 42 plant species here (Table 1). The average projective cover is no more than 20%, the share of Altai onion in the formation of phytocenosis is at the level of 1.8%. The phytobiota of the population is dominated by *Allium nutans* – sp, *A. rubens* – sp. *Thymus serpyllum* – sol. In addition to the dominant species in the group, *Elymus nevskii* Tzvel., *Allium flavescens* Bess., *Paeonia hybrida* Pall., *Corydalis nobilis* (L.) Pers., *Ranunculus polyrhizos* Steph., *Phlomoides tuberosa* L. are noted. Rare specimens are found in the herbage of *Patrinia intermedia* (Hornem.) Roem. et Schult., *Fritillaria verticillata* Willd., from shrubs – a

relic species of Ledebour almond. A moss-lichen cover is developed on the rocks. Among the trees there are singly growing *Pinus sylvestris* L., *Populus laurifolia*, *Betula pendula* Roth.

91 species of vascular plants are involved in the formation of the coenoflora of the surveyed populations of *A. altaicum* on the Sarymsacty, Lineysky and Kalba ridges. At the same time, the similarity of the floristic compositions of the Sarymsacty population in alpine meso-psychro-petrophytic conditions and the Lineysky population in mountain-forest meso-psychro-petrophytic conditions at the level of 65.0% in relation to the entire coenoflora was established, and the Kalba population in the mountain-steppe xero-meso-under petrophytic conditions, this figure was 42.1%.

Given that important indicators in population studies include morphometric parameters of individuals, measurements of the aboveground organs of *A. altaicum* were carried out with the determination of their variation in the examined 3 populations (Table 2).

Table 2

Indicators of morphometric parameters of *Allium altaicum* in the nature of the Kazakhstan Altai (Sarymsacty, Lineysky, Kalba populations)

Indicators	Population name					
	Sarymsacty		Lineysky		Kalba	
	M±m	C_V, %	M±m	C_V, %	M±m	C_V, %
Height of generative shoots, cm	58.33±3.91	21.52	49.08±2.2	15.0	50.73±2.00	23.01
Leaf length, cm	38.73±2.18	17.82	34.23±2.18	14.82	32.33±2.2	18.80
Leaf width at the base, cm	2.51±0.29	21.09	2.46±0.22	26.09	2.03±0.14	21.97
Inflorescence diameter, cm	2.77±0.78	4.6	3.73±2.18	5.9	3.59±0.68	4.3
Seed length, mm	3.26±0.28	8.7	2.9±0.13	4.4	3.30±0.3	9.1
Seed width, mm	1.9±0.17	8.9	1.9±0.12	6.3	2.75±0.04	10.5

The study of average metric values showed that the length and width of seeds have a low level of variability in all populations, regardless of origin. The variability of such indicators as plant height, leaf length and width, as well as the diameter of the inflorescence have a medium and high level of variability, which indicates the ecological plasticity of *A. altaicum* individuals in the surveyed populations and indicates the prospects for their use in the breeding process.

Due to the ability to reproduce vegetatively, the Altai onion forms nests in the Kazakhstan Altai. They consist of a different number of bulbs depending on the age condition, conditionally ranked in the course of research into four groups of nests: young forming a nest, a formed nest, an aging nest and a senile (old nest). Schematic representations of the formed nests of the Altai onion on the ridge. Sarymsacty in alpine conditions, Lineysky ridge – in the mountain-forest and ridge Kalba – in the mountain-steppe are shown in Figures 2-4. An analysis of morphometric and counting indicators revealed similar and distinctive features for each age state of the nest in the surveyed populations, a brief description of which is given below.

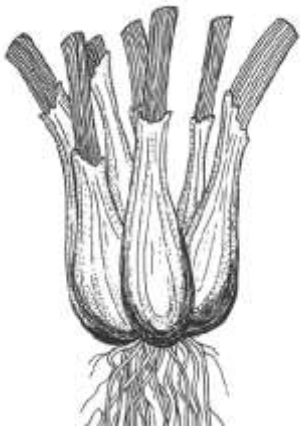

Figure 2. Formed nest of *Allium altaicum* on the Sarymsacty ridge in alpine conditions, 1760 m a.s.l.

Figure 3. The formed nest of *Allium altaicum* on the Lineysky ridge in mountain-forest conditions, 1361 m a.s.l.

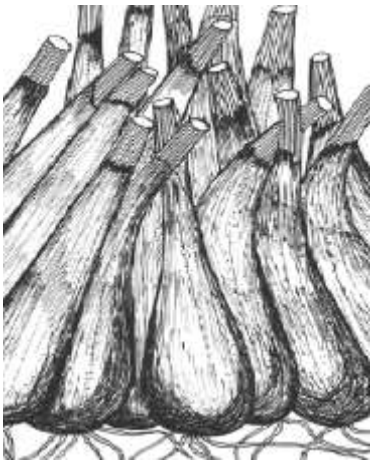

Figure 4. Formed nest of *Allium altaicum* on the Kalba ridge in mountain-steppe conditions, 832 m a.s.l.

✓ The young developing nest is dense, compact, consists mainly of adult vegetative shoots, young generative ones are represented singly. The bulbs in the nest are tightly pressed to each other, there are no dead remains.

✓ The formed nest consists mainly of generative shoots, vegetative shoots are found in separate specimens. In this age state, particulation of the nest begins, which leads to loosening and formation of the central part. The amount of dead remains increases.

✓ An aging nest. It consists mainly of adult shoots that are in a vegetative state, generative ones are found singly. Dead remains accumulate in large quantities; the central part is clearly expressed. An aging nest is characterized by a cessation of weight gain, which is easily established by the ratio of the sizes of cover scales and bulbs, which often predominate in volume over living ones. Rhizomes and roots of other species easily penetrate into an aging nest. The aging of vegetative shoots occurs simultaneously with the aging of the clone; there is no increase in the number of shoots.

✓ Senile (old) nest. Represented only by vegetative underdeveloped shoots. The central part of the nest is empty, filled with dead remains of bulbs. No growth.

According to scientific publications, the potential ability for vegetative propagation in Altai onion already exists in immature plants, but according to our observations, vegetative propagation occurs only in virginal and generative plants.

Based on the analysis of the results of the biometric parameters of the bulbs, it was found that their morphometric and weight indicators are individual, depending on the age state of the nest and the ecological and phytocenotic conditions for the growth of individuals (Table 3).

Table 3

Biometric parameters of *Allium altaicum* bulbs depending on the age state of the nest

Origin of material	Age condition of the nest	Indicators of bulbs in the nest			
		Quantity, pcs	Weight, g	Height, cm	Diameter, cm
Southern Altai, Sarymsacty ridge, 1760 m a.s.l., alpine sample	young emerging	3.70±0.2	12.6±0.7	7.06±0.3	3.08±0.05
	formed	5.80±3.10	13.1±0.3	10.16±0.03	3.08±0.05
	aging	8.00±2.50	10.44±1.12	6.10±0.77	3.4±0.03
	senile	5.62±0.67	7.82±2.41	5.34±1.65	2.24±0.75
Southwestern Altai, Lineysky ridge, 1361 m a.s.l., mountain-forest sample	younge merging	5.00±0.2	16.9±0.75	10.0±0.83	3.5±0.08
	formed	8.50±4.42	16.3±1.83	10.30±0.83	4.25±0.23
	aging	18.50±6.50	12.85±0.67	6.4±2.18	3.79±0.21
	senile	8.5±4.42	7.38±1.83	5.87±2.53	2.87±2.13
Kalba Altai, Kalba ridge, 832 m a.s.l., mountain-steppe sample	younge merging	6.50±0.25	10.6 ± 0.6	9.25±0.72	1.7±0.04
	formed	12.33±5.67	12.7±1.9	9.4±0.72	1.8±0.09
	aging	25.63±7.37	8.1±0.87	5.3±0.21	2.1±0.13
	senile	8.62±0.63	5.82±2.41	4.84±1.65	1.84±0.25

For use as a donor plant for introduction into culture, *A. altaicum* individuals in the population on the Lineysky Ridge, characterized by large bulbs in weight, height and diameter, are promising. This genetic potential can be recommended for hybridization, development of new varieties and improvement of existing ones.

Conclusion

The growth of *A. altaicum* in the Kazakhstan Altai on the Sarymsacty, Lineysky and Kalba ridges is established in a wide range of altitudes in the mountains from 832 to 1870 m above sea level and growing conditions from mountain-steppe to alpine. In phytocenotic terms, the vegetation cover is formed heterogeneously with a projective cover from 20 to 85%. Altai onion occurs sparsely and unevenly over the site. The share of its participation in the formation of phytocenosis ranged from 1.8 to 3.2%. The flora of *A.altaicum* populations on the Sarymsacty, Lineysky and Kalba ridges is formed by 91 species of vascular plants. At the same time, the similarity of the floristic compositions of the Sarymsacty population in alpine meso-psychro-petrophytic conditions and the Lineysky population in mountain-forest meso-psychro-petrophytic conditions at the level of 65.0% in relation to the entire cenoflora was established, and the Kalba population in the mountain-steppe xero-meso- under petrophytic conditions, this figure was 42.1%.

Depending on the geographical location of the populations in the region and the ecological conditions of existence, individuals of *A.altaicum* in the surveyed populations are characterized by individual variant and biomorphological features of the ground mass and bulbs, among which the genetic potential of the Altai onion in the mountain forest conditions of the Southwestern Altai is promising for breeding.

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Қазақстандық Алтайдағы *Allium altaicum* Pall популяциясын зерттеу

Жұмыстың мақсаты қазақстандық Алтай аумағындағы 3 оқшауланған географиялық аймақтан, яғни: Оңтүстік, Оңтүстік-Батыс және Алтай Қалбасы аймақтарынан *Allium altaicum* Pall. популяциясын зерттеу. Сарымсақты, Линейский және Қалба жоталарында маршруттық-барлау әдісімен аумақты зерттеу нәтижесінде тіршілік ету ортасының әртүрлі жағдайларымен және биіктік шектерімен сипатталатын популяциялар зерттелді. Экологиялық-фитоценоздық скрининг анықтағандай, Сарымсақты жотасында популяция альпі белдеуінен, яғни теңіз деңгейінен 1870 м биіктік шегінде, ал Линейский жотасында популяция — таулы-орманда, яғни теңіз деңгейінен 1361 м биіктікте орналасқаны анықталды. Екі популяцияда мезо-психро-петрофиттік өсу жағдайларымен сипатталады. Қалба жотасында популяция таулы-дала ксеро-мезо-петрофиттік жағдайда, теңіз деңгейінен 832 м биіктікте зерттелді. Зерттелген популяцияларда, яғни *A. altaicum* өсетін жерлердегі таудағы топырақ күлгінделген қара топырақты, аздап қышқылды, pH 5,6–5,9, қарашірік мөлшері 13,5%-дан 14,9%-ға дейін жоғары, жер жамылғысы қалыптасқан, шамамен 210–410 г/м^2. Барлық популяцияларда өсімдік жамылғысының негізін шөпті көпжылдықтар құрайды және жіккабаттылығы айқын емес. Фитоценозды қалыптастыруға *A .altaicum* қатысуы Сарымсақты жотасында — 3,2 %, Линейскийде — 2,2%, Қалбада — 1,8% құрайды. Зерттелген популяциялардың флорокешені тамырлы өсімдіктердің 91 түрінен құралған. Сарымсақты популяциясының альпілік мезо-психро-петрофиттік жағдайдағы флористикалық құрамдарының және таулы-орманды мезо-психро-петрофиттік жағдайдағы Линейский құрамының барлық ценофлораға қатысты 65,0% деңгейінде ұқсастығы анықталды, ал Қалба таулы-далалық ксеро-мезо-петрофиттік жағдайдағы бұл құрамның көрсеткіші 42,1 % құрады. *A. altaicum* жерүсті мүшелерінің морфометриялық параметрлерінің өзгермелілігі барлық зерттелген популяцияларда 15,0-ден 26,09%-ға дейін орташа және жоғары өзгергіштік деңгейіне ие, бұл өсімдіктердің экологиялық икемділігін көрсетеді. Табиғатта вегетативті көбею тек виргинилді және генеративті өсімдіктерде жүретіні анықталды. Бұл жағдайда ұялар пайда болады. Үядағы баданалардың биоморфологиялық көрсеткіштері жас ерекшеліктеріне байланысты және бір ценопопуляция шегінде өзгереді.

Кілт сөздер: Allium altaicum Pall., биометриялық параметрлер, қазақстандық Алтай, популяция, өсімдік жамылғысы, флористикалық құрамы.

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Популяционное изучение *Allium altaicum* Pall. в Казахстанском Алтае

Целью данной работы явились популяционные исследования *Allium altaicum* Pall. на территории Казахстанского Алтая в трех территориально изолированных географических районах: Южный, Юго-Западный, Калбинский Алтай. В результате обследования территории маршрутно-рекогносцировочным методом на хр. Сарымсакты, Линейский и Калбинский проведено изучение популяций, которые характеризуются разными условиями среды обитания и высотными пределами. Эколого-фитоценотический скрининг выявил, что на хр. Сарымсакты популяция находится в альпийском поясе в высотном пределе1870 м над ур.м., на хр. Линейский — в горно-лесном,1361 над ур.м. Обе популяции характеризуются мезо-психро-петрофитными условиями произрастания. На хр. Калбинский популяция обследована в горно-степных ксеро-мезо-петрофитных условиях, 832 м над ур. м. Почвы в местах произрастания *A.altaicum* в обследованных популяциях горные оподзоленные черноземы, слабокислые, pH5,6–5,9, с высоким содержанием гумуса от 13,5 до 14,9 %, напочвенный покров сформирован, 210–410 г/м^2. Во всех популяциях основу растительного покрова составляют травянистые многолетники, ярусность не выражена. Участие *A.altaicum* в формировании фитоценоза на хр. Сарымсакты составляет 3,2 %, Линейский — 2,2, Калбинский — 1,8 %. Флорокомплекс обследованных популяций сформирован из 91 вида сосудистых растений. Установлено сходство флористических составов сарымсактинской популяции в альпийских мезо-психро-петрофитных условиях и линейской

в горно-лесных мезо-психро-петрофитных условиях на уровне 65,0 % по отношению ко всей ценофлоре, а калбинской в горно-степных ксеро-мезо-петрофитных условиях этот показатель составил 42,1 %. Вариативность морфометрических параметров надземных органов *A.altaicum* во всех обследованных популяциях имеет средний и высокий уровни изменчивости от 15,0 до 26,09 %, что указывает на экологическую пластичность растений. Установлено, что в природе вегетативное размножение происходит только у виргинильных и генеративных растений. При этом формируются гнезда. Биоморфологические показатели луковиц в гнезде носят четко выраженный возрастной характер и варьируют в пределах одной и той же ценопопуляции.

Ключевые слова: *Allium altaicum* Pall., биометрические параметры, Казахстанский Алтай, популяция, растительный покров, флористический состав.

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